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Melting of Wigner Crystal on Helium in Quasi-On--Dimensional Geometry

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Abstract

© 2015, Springer Science+Business Media New York. We discuss melting of a Wigner crystal formed on a free surface of superfluid 4He, in quasi-one-dimensional (Q1D) channels of width between 5 and 15 μ. We reexamine our previous transport data (Ikegami et al. in Phys Rev B 82:201104(R), 2010), in particular, by estimating the number of electrons across the channel in a more accurate way with the aid of numerical calculations of distributions of the electrons in the channels. The results of reexamination indicate more convincingly that the melting of the Wigner crystal in the Q1D geometry is understood by the finite size effect on the Kosterlitz–Thouless–Halperin–Nelson–Young melting process. We also present technical details of the transport measurements of the electrons in a Q1D geometry, including a fabrication method of devices used for the transport measurements, numerical simulations of response of the devices, and a procedure for analyzing transport data.

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Keywords

Melting, Quasi-one-dimensional system, Transport measurement, Wigner crystal